Ch 3 The Atom

Democritus - ancient Greek philosopher

Ch 3 The Atom

Democritus - ancient Greek philosopher

↳ coined the "atom"

↳

Ch 3 The Atom

Democritus - ancient Greek philosopher

↳ coined the "atom"

↳ matter is made of indivisible particles

Ch 3 The Atom

Democritus - ancient Greek philosopher
↳ coined the "atom"
↳ matter is made of indivisible particles

Aristotle - 4 element theory
↳ Earth, Air, Fire, Water

Ch 3 The Atom

Democritus - ancient Greek philosopher

↳ coined the "atom"

↳ matter is made of indivisible particles

Aristotle - 4 element theory

↳ Earth, Air, Fire, Water

Alchemists - early chemists

Alchemists - early chemists

↳ turn lead into Gold / create elixirs of youth

Alchemists - early chemists

↳ turn lead into Gold / create elixirs of youth

Lavoisier - Father of Chemistry

Alchemists - early chemists
↳ turn lead into Gold / create elixirs of youth

Lavoisier - Father of Chemistry
↳ proved LCM
↳ wrote 1st Chem text Book

Alchemists - early chemists
↳ turn lead into Gold / create elixirs of youth

Lavoisier - Father of Chemistry
↳ proved LCM
↳ wrote 1st Chem text Book
↳ proved O_2 Reqd for Combustion

John Dalton:

- Developed an Atomic Theory based on LCM, LDC

John Dalton:

↳ Developed an Atomic Theory based on LCM, LDC

1807 Atomic Theory

1.

John Dalton:

↳ Developed an Atomic Theory based on LCM, LDC

1807 Atomic Theory

1. All matter is composed of atoms

John Dalton:

↳ Developed an Atomic Theory based on LCM, LDC

1807 Atomic Theory

1. All matter is composed of atoms
2. Atoms of the same element have the same properties

John Dalton:

↳ Developed an Atomic Theory based on LCM, LDC

1807 Atomic Theory

1. All matter is composed of atoms
2. Atoms of the same element have the same properties
   " " " different " " " different "

John Dalton:

↳ Developed an Atomic Theory based on LCM, LDC

1807 Atomic Theory

1. All matter is composed of atoms
2. Atoms of the same element have the same properties
" " " different " " " different "
3. Atoms cannot be created, subdivided, nor destroyed

John Dalton:

↳ Developed an Atomic Theory based on LCM, LDC

1807 Atomic Theory

1. All matter is composed of atoms
2. Atoms of the same element have the same properties
3. Atoms cannot be created, subdivided, nor destroyed
4. Atoms combine in small whole # Ratios to form compounds

Cl_2, H_2O, ~~F_2O~~

John Dalton:

↳ Developed an Atomic Theory based on LCM, LDC

1807 Atomic Theory

1. All matter is composed of atoms
2. Atoms of the same element have the same properties
" " " different " " " different "
3. Atoms cannot be created, subdivided, nor destroyed
4. Atoms combine in small whole # Ratios to form compounds CO_2, H_2O, ~~Fe_2O_3~~
5. In Rxns, Atoms separate, Rearrange, and Recombine to form Comp's

John Dalton:

↳ Developed an Atomic Theory based on LCM, LDC

1807 Atomic Theory

1. All matter is composed of atoms
2. Atoms of the same element have the same properties
3. Atoms cannot be created, subdivided, nor destroyed
4. Atoms combine in small whole # Ratios to form compounds
5. In Rxns, Atoms separate, Rearrange, and Recombine to form Comp's

Not True Today
Isotopes – same element different Mass

CO_2, H_2O, ~~F_2O~~

John Dalton:

↳ Developed an Atomic Theory based on LCM, LDC

1807 Atomic Theory

1. All matter is composed of atoms
2. ~~X~~ Atoms of the same element have the same properties ← Not True Today — Isotopes — same element, different Mass
3. Atoms cannot be created, subdivided, nor destroyed
4. Atoms combine in small whole # Ratios to form compounds CO_2, H_2O, ~~F_2O~~
5. In Rxns, Atoms separate, Rearrange, and Recombine to form Comp's

John Dalton:

↳ Developed an Atomic Theory based on LCM, LDC

1807 Atomic Theory

1. All matter is composed of atoms
2. ~~X~~ Atoms of the same element have the same properties ← Not True Today ∴ Isotopes – same element different Mass
3. ~~X~~ Atoms cannot be created, subdivided, nor destroyed ← Nuclear Bombs; man-made element rxn; p, n, e⁻
4. Atoms combine in small whole # Ratios to form compounds CO_2, H_2O, ~~F_2O~~
5. In Rxns, Atoms separate, Rearrange, and Recombine to form Comp's

anatomy of an atom

anatomy of an atom

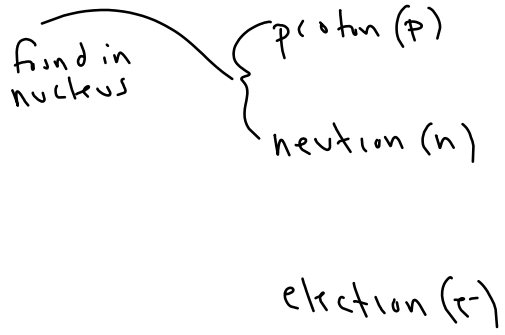
anatomy of an atom

proton (p)

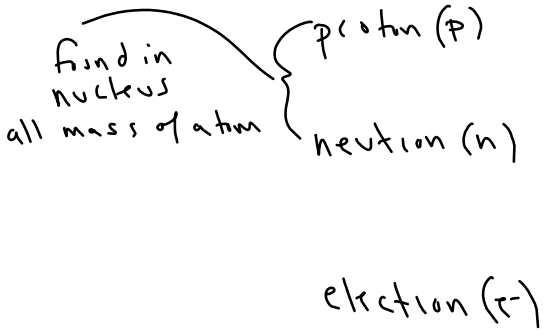
neutron (n)

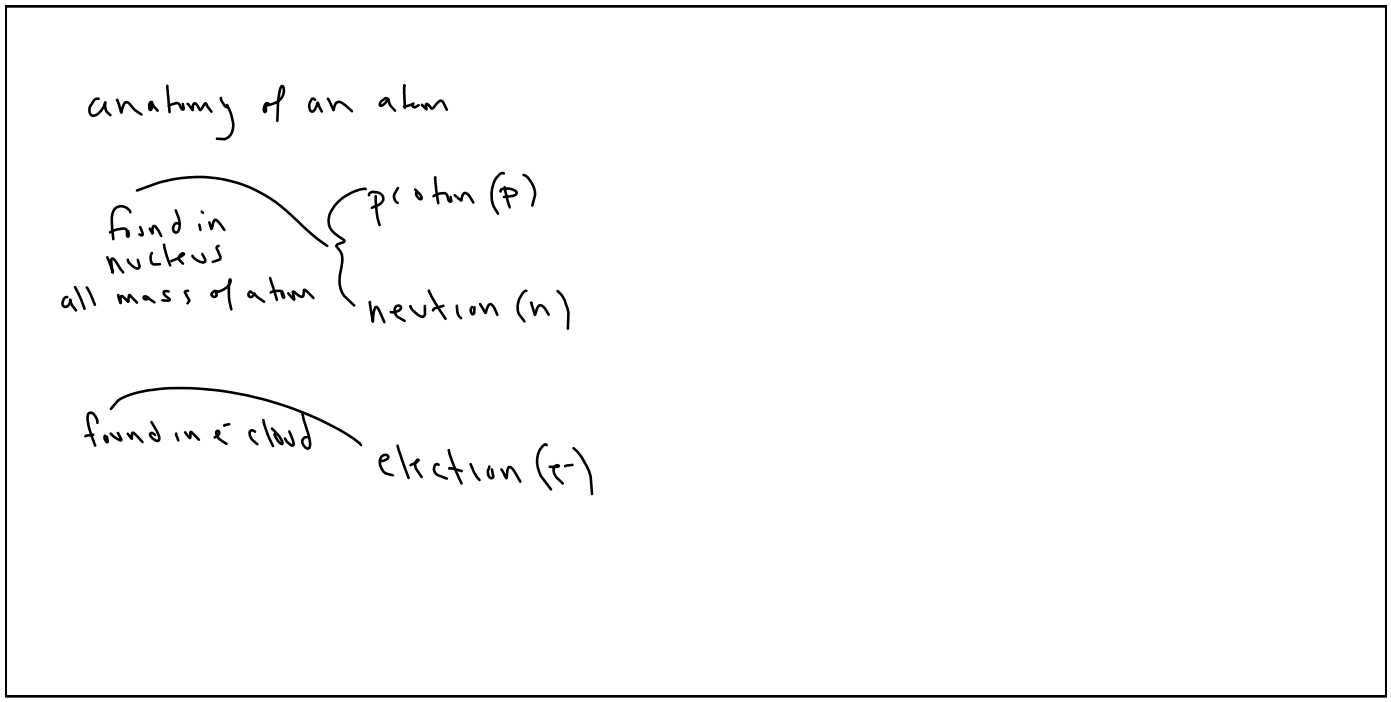
electron (e^-)

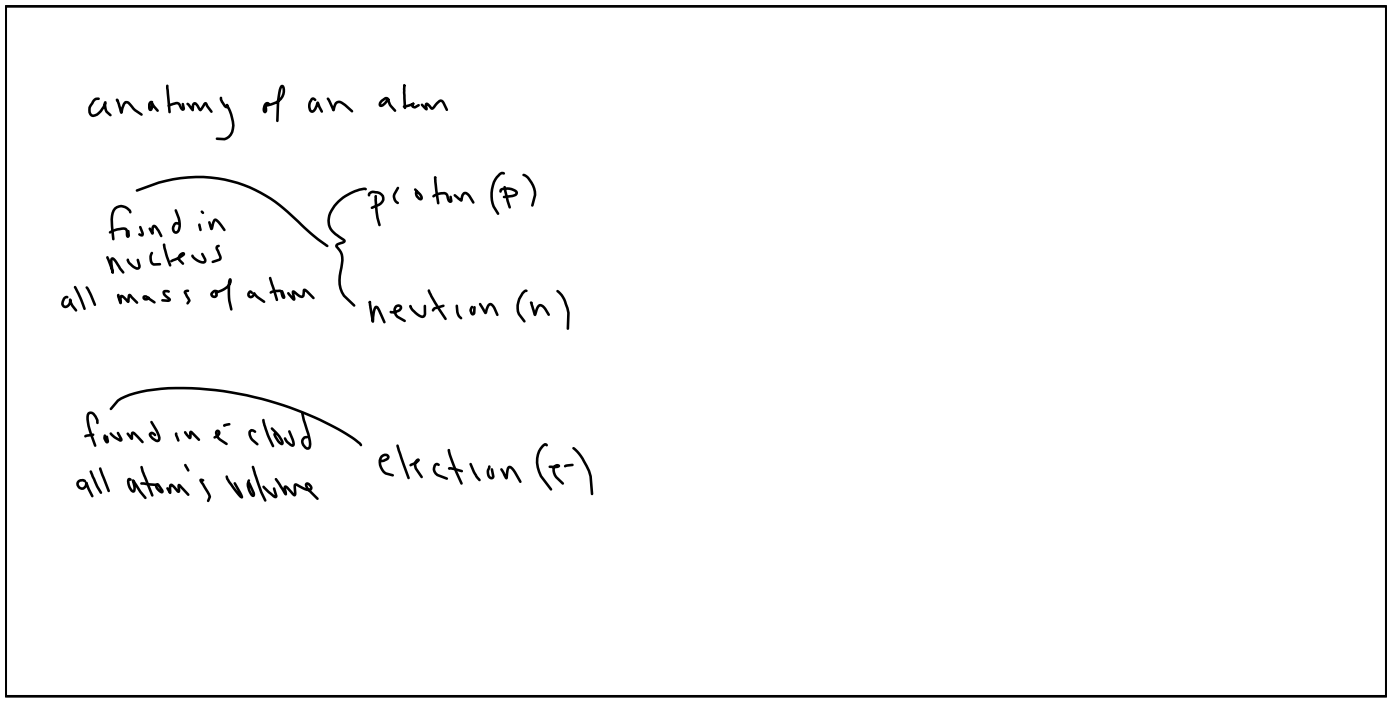
anatomy of an atom

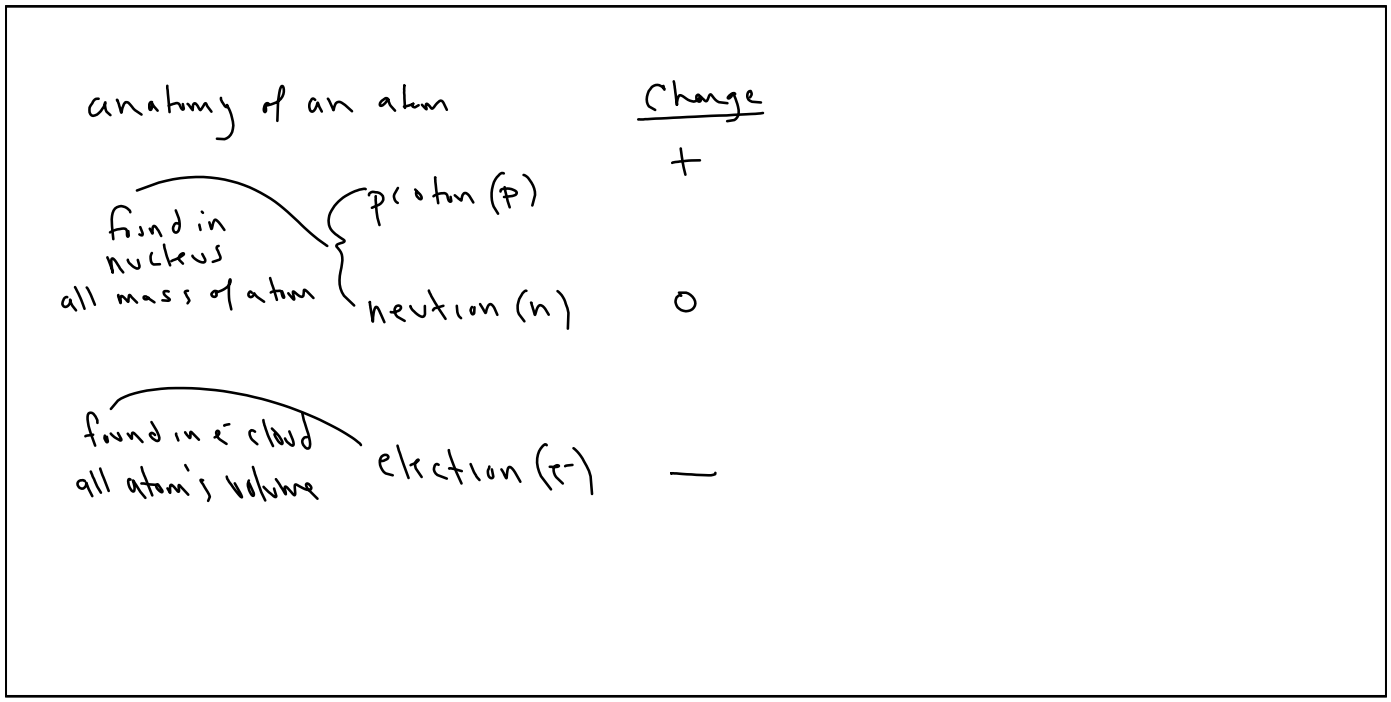


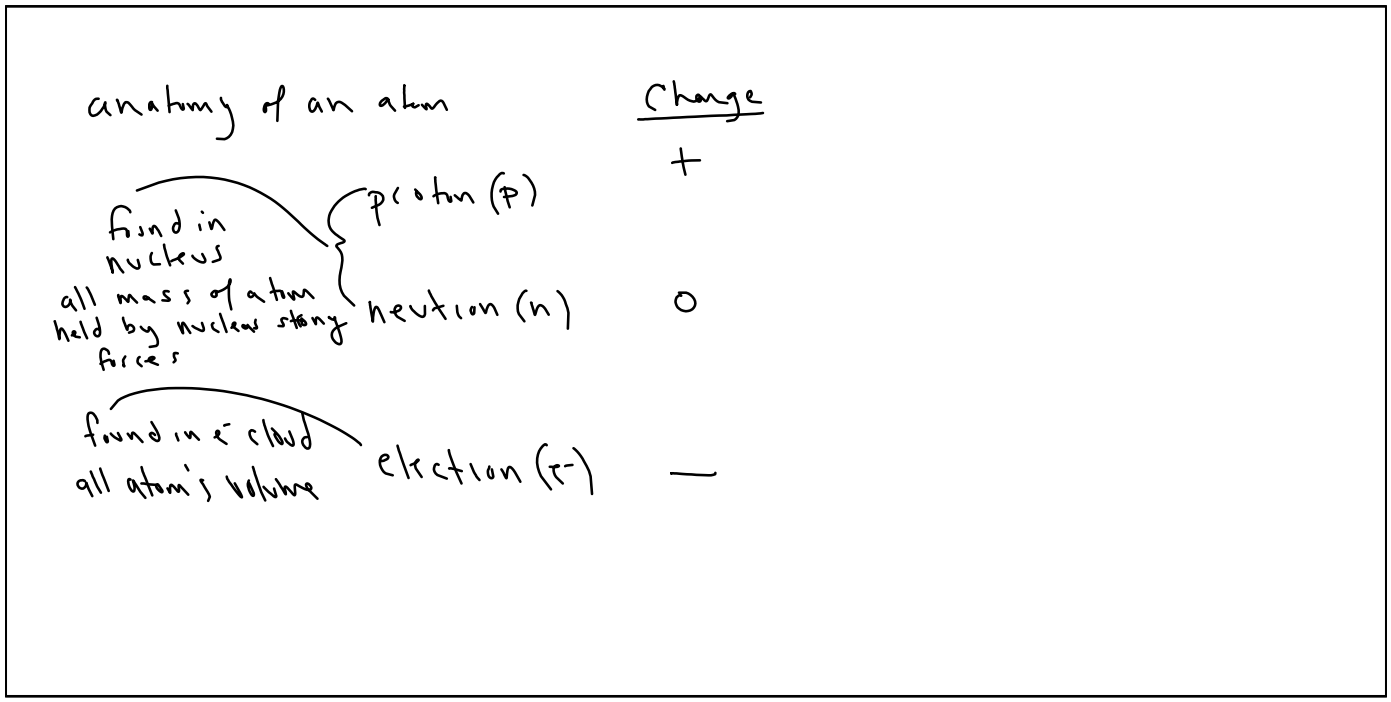
anatomy of an atom

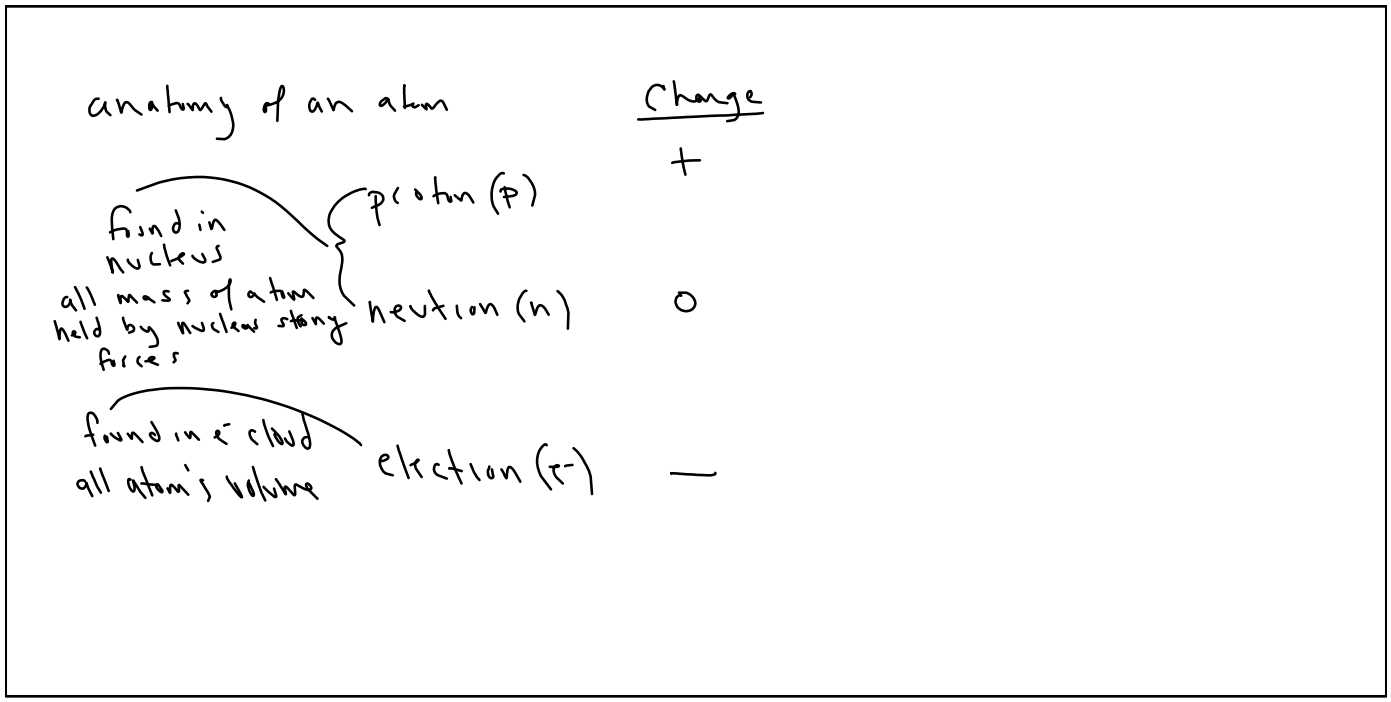


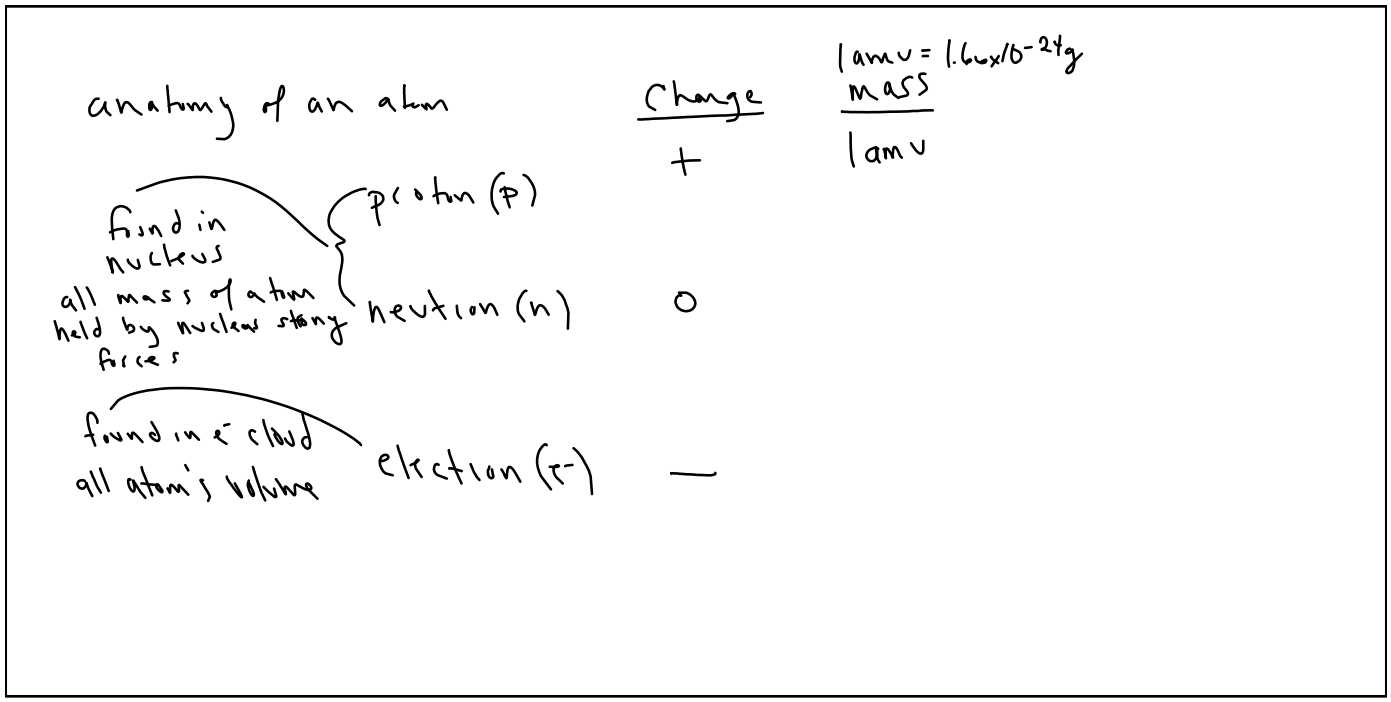

anatomy of an atom
found in nucleus
all mass of atom
proton (p)
neutron (n)
found in e⁻ cloud
electron (e⁻)


anatomy of an atom
found in nucleus
all mass of atom
proton (p)
neutron (n)
found in e⁻ cloud
all atom's volume
electron (e⁻)


anatomy of an atom
Charge
found in nucleus
all mass of atom
proton (p)
+
neutron (n)
0
found in e⁻ cloud
all atom's volume
electron (e⁻)
—


anatomy of an atom
Charge
found in nucleus
all mass of atom held by nuclear strong forces
proton (p)
+
neutron (n)
0
found in e⁻ cloud
all atom's volume
electron (e⁻)
—


anatomy of an atom
Charge
found in nucleus
all mass of atom held by nuclear strong forces
proton (p)
+
neutron (n)
0
found in e⁻ cloud
all atom's volume
electron (e⁻)
—

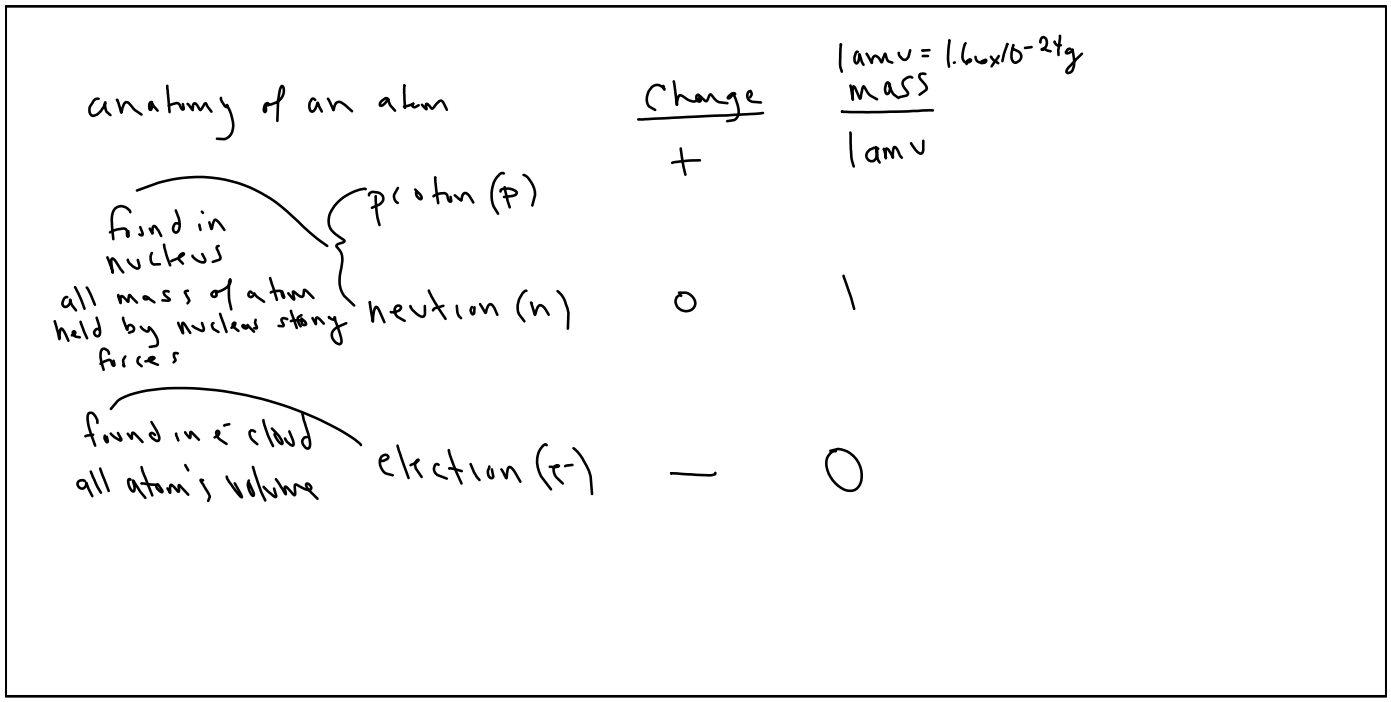

anatomy of an atom
Charge
mass
1 amu = 1.66x10⁻²⁴g
1 amu
found in nucleus
all mass of atom held by nuclear strong forces
proton (p)
+
neutron (n)
0
found in e⁻ cloud
all atom's volume
electron (e⁻)
—

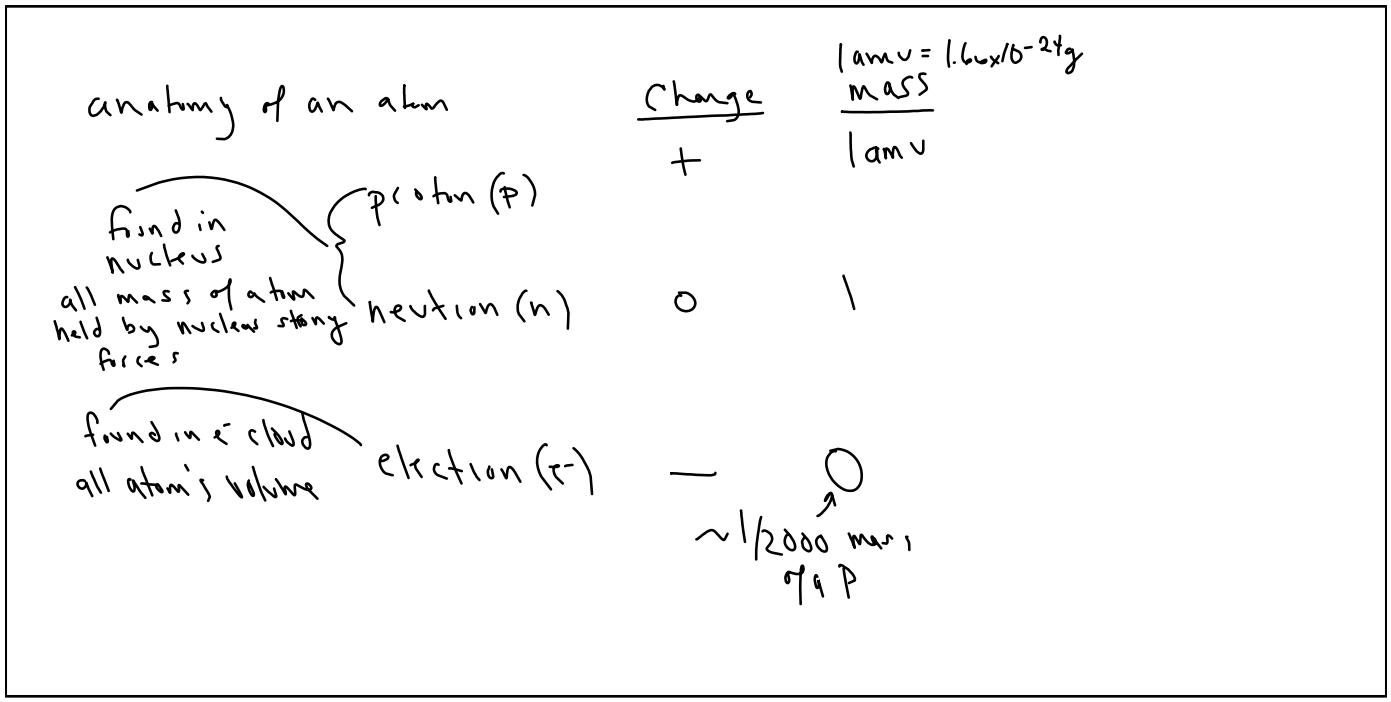
anatomy of an atom

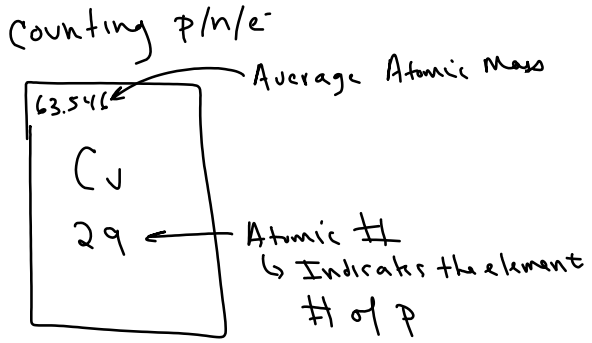
	Charge	mass
		1 amu = 1.66×10^{-24} g
proton (p)	+	1 amu
neutron (n)	0	1
electron (e^-)	—	

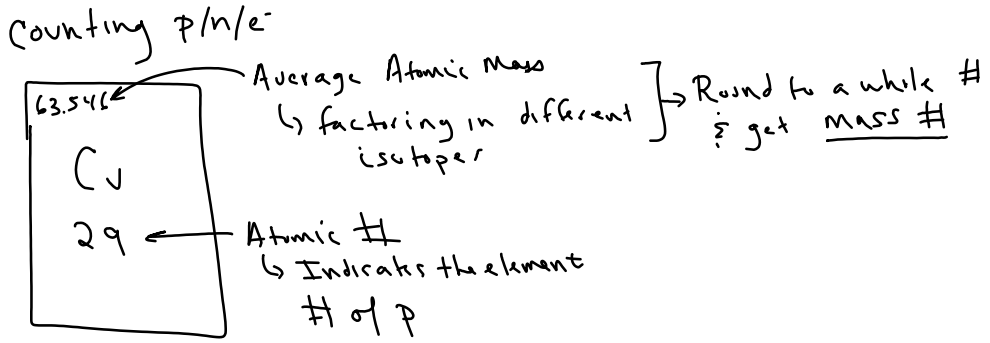
found in nucleus
all mass of atom held by nuclear strong forces

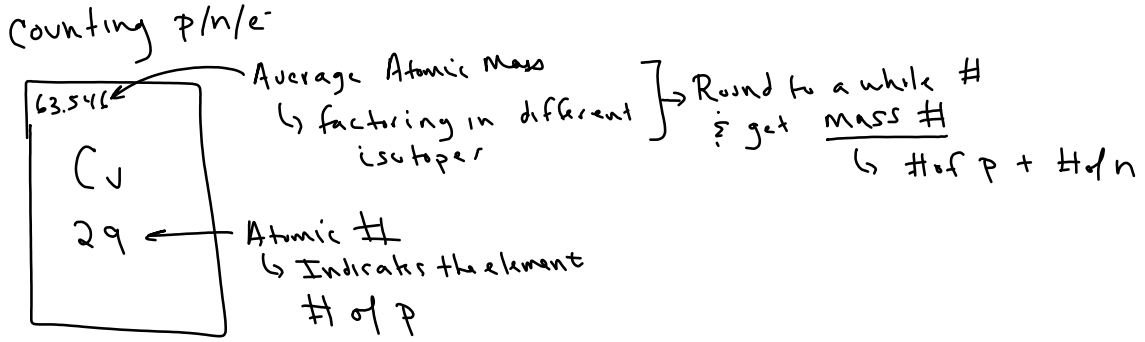
found in e^- cloud
all atom's volume


anatomy of an atom
Charge
mass
1 amu = 1.66x10⁻²⁴g
found in nucleus
all mass of atom held by nuclear strong forces
proton (p)
neutron (n)
found in e⁻ cloud
all atom's volume
electron (e⁻)
+
0
—
1
1 amu
0

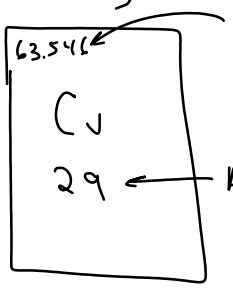

anatomy of an atom
Charge
mass
1 amu = 1.66x10⁻²⁴g
found in nucleus
all mass of atom held by nuclear strong forces
proton (p)
+
1 amu
neutron (n)
0
1
found in e⁻ cloud
all atom's volume
electron (e⁻)
—
0
~1/2000 mass of p


Counting p/n/e⁻
Average Atomic Mass
63.546
Cu
29
Atomic #
↳ Indicates the element
# of p


Counting p/n/e⁻
63.546
Cu
29
Average Atomic Mass
↳ factoring in different isotopes
Round to a whole # ∴ get mass #
Atomic #
↳ Indicates the element
# of p


Counting p/n/e⁻
63.546
Cu
29
Average Atomic Mass
↳ factoring in different isotopes
Round to a whole #
∴ get mass #
↳ # of p + # of n
Atomic #
↳ Indicates the element
# of p

Counting p/n/e⁻



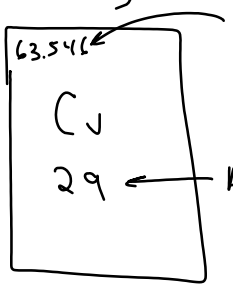
Average Atomic Mass
↳ factoring in different isotopes
→ Round to a whole # ∴ get mass #
↳ # of p + # of n

Atomic #
↳ Indicates the element
# of p

p = 29

n =

Counting p/n/e⁻



Average Atomic Mass
↳ factoring in different isotopes
→ Round to a whole # ∴ get mass #
↳ # of p + # of n

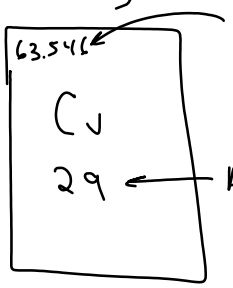
Atomic #
↳ Indicates the element
# of p

# of n = mass # − atomic #

p = 29

n =

Counting p/n/e⁻



Average Atomic Mass
↳ factoring in different isotopes
→ Round to a whole # ∴ get mass #
↳ # of p + # of n

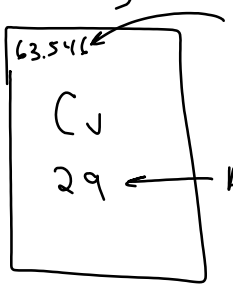
Atomic #
↳ Indicates the element
# of p

# of n = mass # − atomic #

p = 29

n = 64 − 29 =

Counting p/n/e⁻



Average Atomic Mass
↳ factoring in different isotopes
→ Round to a whole # ∴ get mass #
↳ # of p + # of n

Atomic #
↳ Indicates the element
# of p

# of n = mass # − atomic #

p = 29

n = 64 − 29 = 35

#of p = atomic #

#of n = mass # - atomic #

# of p = atomic #

# of n = mass # - atomic #

# of e⁻ ⟶ for atoms
# of p = # of e⁻

# of p = atomic #

# of n = mass # - atomic #

# of e⁻ ⟶ for atoms
# of p = # of e⁻

# of p = atomic #

# of n : mass # - atomic #

# of e⁻ ⟶ for atoms
# of p = # of e⁻

For ions - charged atoms

# of p = atomic #

# of n : mass # - atomic #

# of e⁻ ⟶ for atoms
# of p = # of e⁻

For ions - charged atoms
+ ion → cation

# of p = atomic #

# of n = mass # - atomic #

# of e⁻ → for atoms
# of p = # of e⁻

For ions - charged atoms
+ ion → cation
− ion → anion

#of p = atomic #

#of n : mass # - atomic #

#of e⁻ ⟶ for atoms
#of p = #of e⁻

For ions - charged atoms

+ ion → cation
↳ less e⁻ based on the charge
+ → lost 1 e⁻
2+ → lost 2 e⁻

− ion → anion

#of p = atomic #

#of n : mass # - atomic #

#of e⁻ ⟶ for atoms
#of p = #of e⁻

For ions - charged atoms

+ ion → cation
↳ less e⁻ based on the charge
+ → lost 1 e⁻
2+ → lost 2 e⁻

− ion → anion
↳ gain e⁻ based on the charge
−

# of p = atomic #

# of n = mass # - atomic #

# of e⁻ → for atoms
# of p = # of e⁻

For ions - charged atoms

+ ion → cation
↳ less e⁻ based on the charge
+ → lost 1 e⁻
2+ → lost 2 e⁻

− ion → anion
↳ gain e⁻ based on the charge
− → 1 more e⁻
2− → 2 more e⁻

p n e^-

Mg

W

Ni^{2+}

S^{2-}

	p	n	e^-
Mg	12		
W			
Ni^{2+}			
S^{2-}			

	p	n	e^-
Mg	12	12	12

W

Ni^{2+}

S^{2-}

	p	n	e^-
Mg	12	12	12
W	74	110	

Ni^{2+}

S^{2-}

	p	n	e^-
Mg	12	12	12
W	74	184 - 74 = 110	

Ni^{2+}

S^{2-}

	p	n	e⁻
Mg	12	12	12
W	74	184 − 74 = 110	74

Ni^{2+}

S^{2-}

	p	n	e⁻
Mg	12	12	12
W	74	110 (184 - 74)	74
Ni^{2+}	28	31	26
S^{2-}			

	p	n	e⁻
Mg	12	12	12
W	74	110 (184 − 74)	74
Ni^{2+}	28	31	26
S^{2-}			

+28 + ? : +2

	p	n	e⁻
Mg	12	12	12
W	74	110 (184 − 74)	74
Ni^{2+}	28	31	26 (2 less e⁻ than p B/c +2 charge)
S^{2-}	16	16	18

+28 + ? = +2

Average
Atomic Mass

Average Atomic Mass

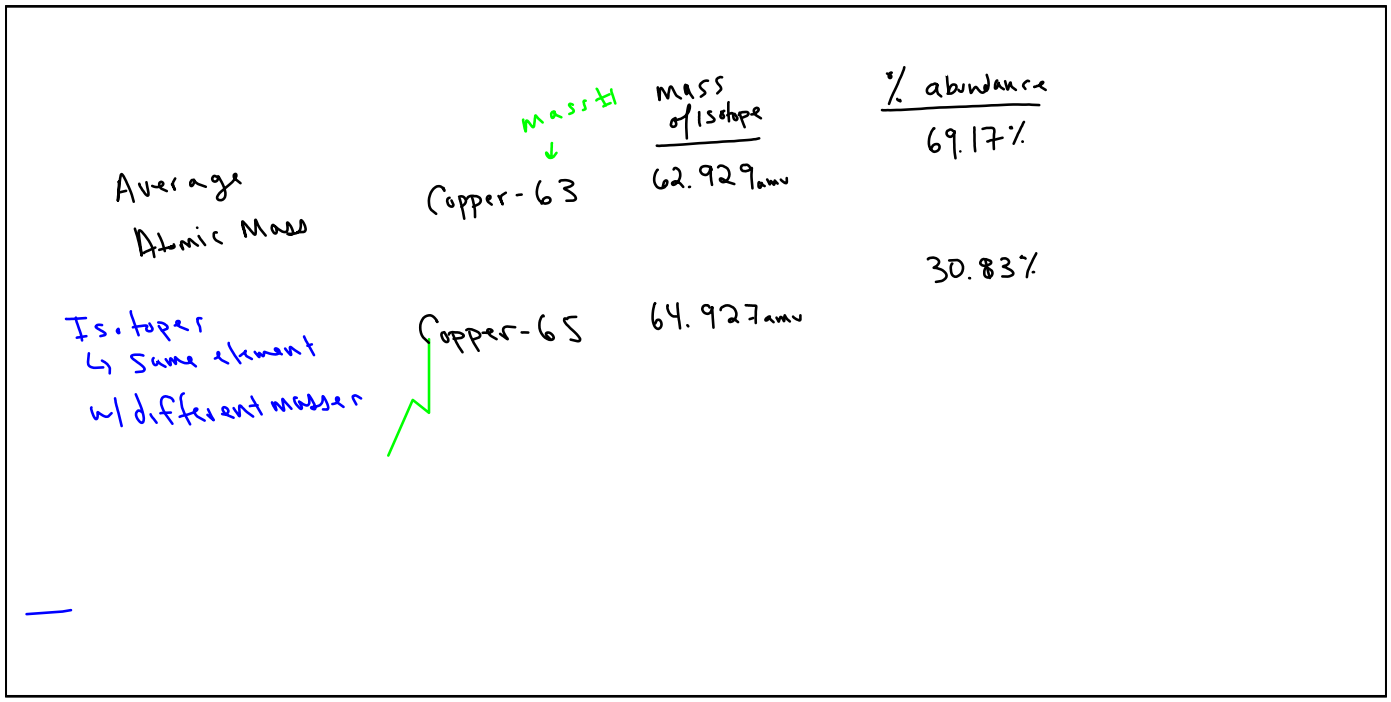
Copper-63

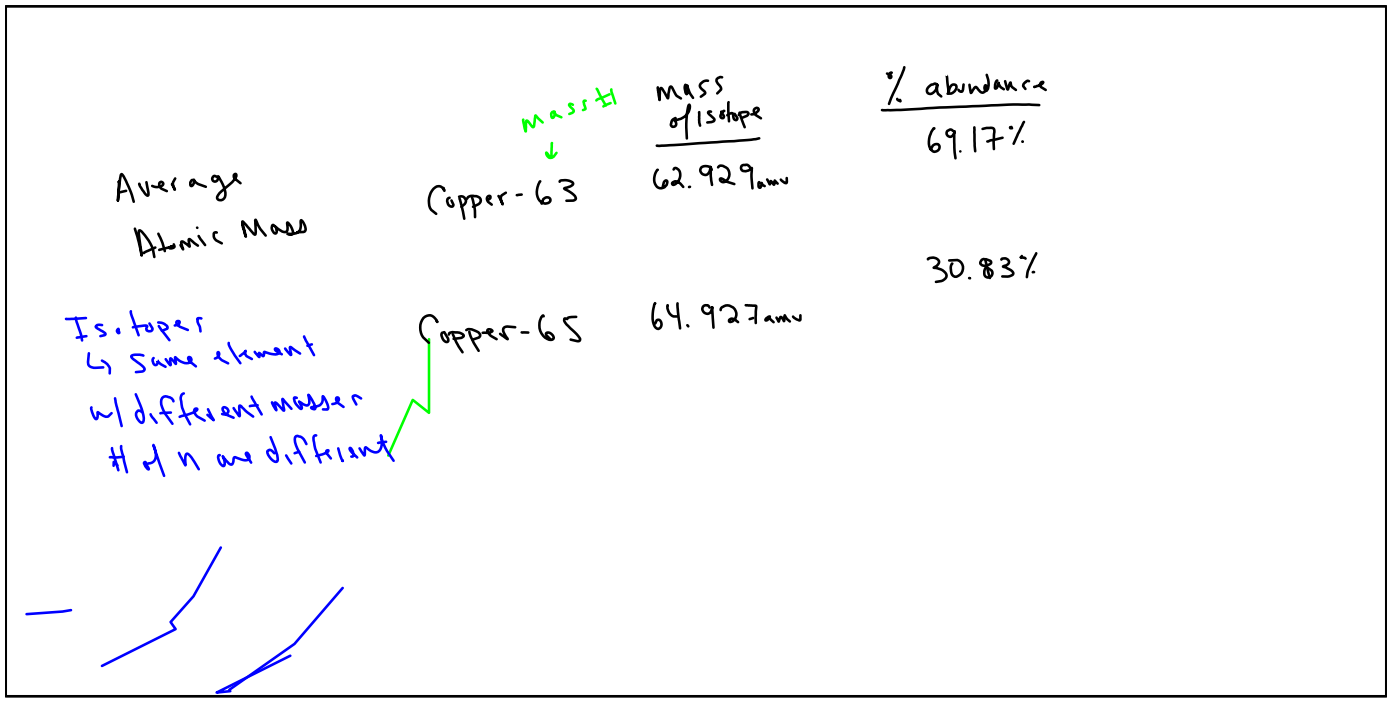
Copper-65

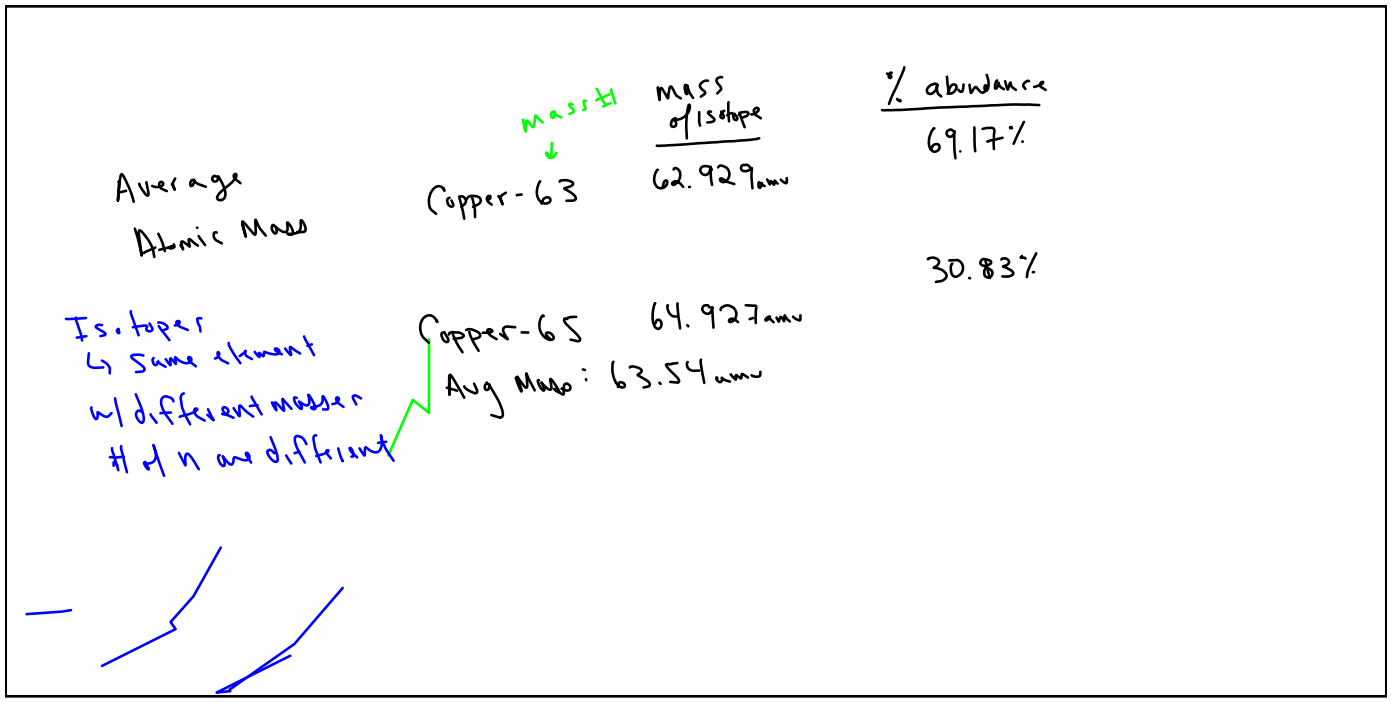
		mass of isotope	% abundance
Average Atomic Mass	Copper-63	62.929 amu	69.17%
	Copper-65	64.927 amu	30.83%

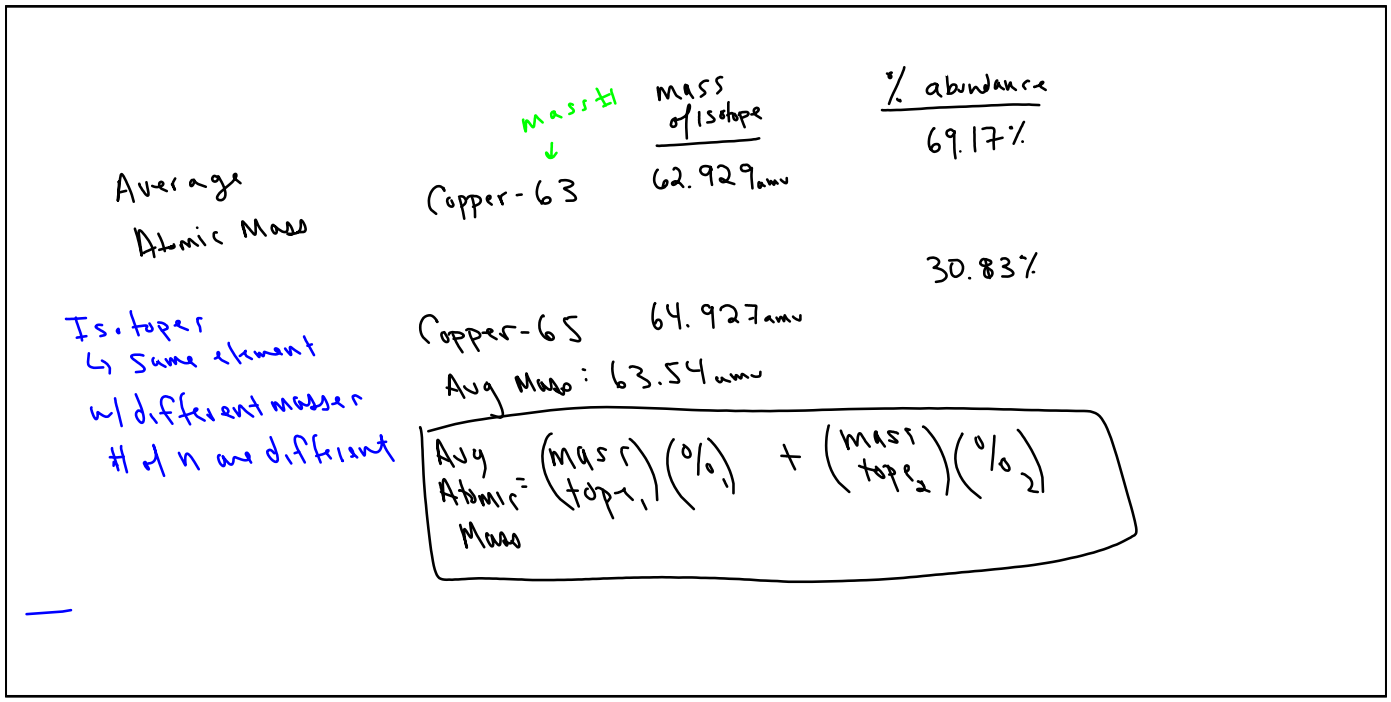
		mass of isotope	% abundance
Average Atomic Mass	Copper-63	62.929 amu	69.17%
	Copper-65	64.927 amu	30.83%

Isotopes
↳ same element
w/ different masses


mass #
mass of isotope
% abundance
Average Atomic Mass
Copper-63
62.929amu
69.17%
30.83%
Isotopes
↳ same element w/ different masses
Copper-65
64.927amu


mass #
mass of isotope
% abundance
Average Atomic Mass
Copper-63
62.929amu
69.17%
30.83%
Isotopes
same element
w/ different masses
# of n are different
Copper-65
64.927amu


mass #
mass of isotope
% abundance
Average Atomic Mass
Copper-63
62.929 amu
69.17%
30.83%
Isotopes
same element
w/ different masses
# of n are different
Copper-65
64.927 amu
Avg Mass: 63.54 amu


mass #
mass of isotope
% abundance
Average Atomic Mass
Copper-63
62.929 amu
69.17%
30.83%
Isotopes
↳ same element
w/ different masses
# of n are different
Copper-65
64.927 amu
Avg Mass: 63.54 amu
Avg Atomic Mass = (mass top 1)(%1) + (mass top 2)(%2)

$(62.929\ \text{amu})(0.6917)$

$(62.929\ \text{amu})(0.6917) + (64.927\ \text{amu})(0.3085) = \boxed{63.544\ \text{amu}}$

% must
Be decimal

^{10}B (19.78%), ^{11}B (80.22%)

mass

^{10}B (19.78%) , ^{11}B (80.22%)

$(10\ amu)(0.1978) + (11\ amu)(0.8022)$

mass

^{10}B (19.78%), ^{11}B (80.22%)

$(10\ amu)(0.1978) + (11\ amu)(0.8022)$

$1.978\ amu + 8.824\ amu = 10.802\ amu$

Mole Concept

Mole Concept
↳ Mole -> "scientific dozen"

Mole Concept

↳ Mole -> "scientific dozen"

1 mol → 6.022×10^{23} "particles"

Mole Concept

↳ Mole -> "scientific dozen"

1 mol → 6.022×10^{23} "particles"

↳ elements → atoms

Mole Concept

↳ Mole -> "scientific dozen"

1 mol → 6.022×10^{23} "particles"

↳ elements → atoms

compounds → molecules / formula units

Mole Concept

↳ Mole -> "scientific dozen"

1 mol → 6.022×10^{23} "particles"

element

↳ elements → atoms

compounds → molecules / formula units

Mole Concept
↳ Mole -> "scientific dozen"

1 mol → 6.022×10^{23} atoms
element
↳ elements → atoms
compounds → molecules / formula units

Mole Concept

↳ Mole -> "scientific dozen"

Avogadro's #

1 mol → 6.022×10^{23} atoms

element

↳ elements → atoms

compounds → molecules / formula units

Mole Concept

↳ Mole -> "scientific dozen"

Avogadro's #

1 mol → 6.022×10^{23} atoms

element

↳ elements → atoms

compounds → molecules / formula units

Molar Mass

Mole Concept

↳ Mole -> "scientific dozen"

Avogadro's #

1 mol → 6.022×10^{23} atoms

element

↳ elements → atoms

compounds → molecules / formula units

Molar Mass - # of grams in 1 mole of that element

Mole Concept

↳ Mole -> "scientific dozen" — Avogadro's #

1 mol → 6.022×10^{23} atoms
element

↳ elements → atoms

compounds → molecules / formula units

Molar Mass - # of grams in 1 mole of that element

Mole Concept

↳ Mole -> "scientific dozen"

Avogadro's #

1 mol → 6.022×10^{23} atoms

element

↳ elements → atoms

compounds → molecules / formula units

Molar Mass - # of grams in 1 mole of that substance

↳ for elements -

Mole Concept

↳ Mole -> "scientific dozen" — Avogadro's #

1 mol → 6.022×10^{23} atoms

element

↳ elements → atoms

compounds → molecules / formula units

Molar Mass - # of grams in 1 mole of that substance

↳ for elements - same as atomic mass on the Periodic Table

Mole Concept

↳ Mole -> "scientific dozen"

Avogadro's #

1 mol → 6.022×10^{23} atoms

element

↳ elements → atoms

compounds → molecules / formula units

Molar Mass - # of grams in 1 mole of that substance

↳ for elements - same as atomic mass on the Periodic Table

for Cu → $\frac{63.55\ g\ Cu}{1\ mole\ Cu}$

Mole Concept

↳ Mole -> "scientific dozen"

Avogadro's #

1 mol → 6.022×10^{23} atoms
element

↳ elements → atoms

compounds → molecules / formula units

Molar Mass - # of grams in 1 mole of that substance

↳ for elements - same as atomic mass on the Periodic Table

for Cu → $\frac{63.55\ g\ Cu}{1\ mole\ Cu}$

Au → $\frac{196.96\ g\ Au}{1\ mol\ Au}$

21 mol Sb : ? atoms

21 mol Sb : ? atoms Sb

21 mol Sb : ? atoms Sb

21 mol Sb

21 mol Sb : ? atoms Sb

21 mol Sb x ———

21 mol Sb : ? atoms Sb

21 mol Sb x ____ atoms Sb / ____

$21\ mol\ Sb : \frac{?}{}\ atoms\ Sb$

$21\ mol\ Sb \times \frac{atoms\ Sb}{mol\ Sb}$

$21\ mol\ Sb : \underline{?}\ atoms\ Sb$

$21\ \cancel{mol\ Sb} \times \frac{atoms\ Sb}{\cancel{mol\ Sb}}$

$21\ mol\ Sb : \underline{\ ?\ }\ atoms\ Sb$

$21\ \cancel{mol\ Sb} \times \frac{6.022 \times 10^{23}\ atoms\ Sb}{1\ \cancel{mol\ Sb}}$

$21\ mol\ Sb : \underline{?}\ atoms\ Sb$

$21\ \cancel{mol\ Sb} \times \frac{6.022 \times 10^{23}\ atoms\ Sb}{1\ \cancel{mol\ Sb}} = 1.26 \times 10^{25}\ atoms\ Sb$

$21\ mol\ Sb : \underline{?}\ atoms\ Sb$

$$21\ \cancel{mol\ Sb} \times \frac{6.022 \times 10^{23}\ atoms\ Sb}{1\ \cancel{mol\ Sb}} = 1.26 \times 10^{25}\ atoms\ Sb$$

21 mol Sb : ? atoms Sb

$$21 \text{ mol Sb} \times \frac{6.022 \times 10^{23} \text{ atoms Sb}}{1 \text{ mol Sb}} = 1.26 \times 10^{25} \text{ atoms Sb}$$

8 mil Bk : ? atom Bk

$21\ mol\ Sb = \underline{?}\ atoms\ Sb$

$$21\ \cancel{mol\ Sb} \times \frac{6.022\times10^{23}\ atoms\ Sb}{1\ \cancel{mol\ Sb}} = 1.26\times10^{25}\ atoms\ Sb$$

$8\ mil\ Bk = \underline{?}\ atom\ Bk$

$$8\ mil\ \cancel{Bk} \times \frac{6\times10^{23}\ atoms\ Bk}{1\ mil\ \cancel{Bk}}$$

21 mol Sb : ? atoms Sb

$$21 \text{ mol Sb} \times \frac{6.022 \times 10^{23} \text{ atoms Sb}}{1 \text{ mol Sb}} = 1.26 \times 10^{25} \text{ atoms Sb}$$

8 mil Bk : ? atom Bk

$$8 \text{ mil Bk} \times \frac{6 \times 10^{23} \text{ atoms Bk}}{1 \text{ mil Bk}} = 4.82 \times 10^{24} \text{ atoms Bk}$$

21 mol Sb : ? atoms Sb

$$21 \text{ mol Sb} \times \frac{6.022 \times 10^{23} \text{ atoms Sb}}{1 \text{ mol Sb}} = 1.26 \times 10^{25} \text{ atoms Sb}$$

8 mil Bk : ? atom Bk

$$8 \text{ mil Bk} \times \frac{6 \times 10^{23} \text{ atoms Bk}}{1 \text{ mil Bk}} = 4.82 \times 10^{24} \text{ atoms Bk}$$

Mol ⟷ mass

Mol ⟷ mass

↳ to convert b/w g & mols use the Molar Mass on the periodic table

Mol ⟷ mass

↳ to convert b/w g & mols
use the Molar Mass on the
periodic table ↑ Atomic Mass

Mol ⟷ mass

↳ to convert b/w g & mols use the Molar Mass on the periodic table ← Atomic Mass

Magnesium → 24.3 g/mol

31.0 g Mg : ? mol Mg

Mol ⟷ mass

↳ to convert b/w g & mols use the Molar Mass on the periodic table ← Atomic Mass

Magnesium → 24.3 g/mol

31.0 g Mg : ? — mol Mg

$31.0\,g\,Mg \times \frac{mol\,Mg}{Mg}$

Mol ⟷ mass

↳ to convert b/w g & mols use the Molar Mass on the periodic table ← Atomic Mass

Magnesium → 24.3 g/mol

31.0 g Mg : ? — mol Mg

$$31.0\,g\,Mg \times \frac{1\ mol\,Mg}{24.3\ g\ Mg}$$

Mol ⟷ mass

↳ to convert b/w g & mols use the Molar Mass on the periodic table ← Atomic Mass

Magnesium → 24.3 g/mol

31.0 g Mg : ? mol Mg

$31.0\ g\ Mg \times \frac{1\ mol\ Mg}{24.3\ g\ Mg} = 1.27\ mol\ Mg$

Mol ⟷ mass

↳ to convert b/w g & mols use the Molar Mass on the periodic table ← Atomic Mass

Magnesium → 24.3 g/mol

31.0 g Mg : ? mol Mg

$31.0\,g\,Mg \times \frac{1\ mol\ Mg}{24.3\ g\ Mg} = 1.27\ mol\ Mg$

$31.0\ g\ O_3 = \underline{\ ?\ }\ m.l\ O_3$

$31.0\,g\,Os = \frac{?}{}\,mol\,Os$

$31.0\,g\,Os \times \frac{mol\,Os}{g\,Os}$

$31.0\,g\,Os = \underline{?}\,mol\,Os$

$31.0\,g\,Os \times \frac{1\ mol\,Os}{190.2\,g\,Os} = 0.163\,mol\,Os$

$26.8\ mol\ O = \underline{?}\ g\ O$

$26.8\ mol\ O \times$

$26.8\ mol\ O = \underline{?}\ g\ O$

$26.8\ mol\ O \times \frac{g\ O}{mol\ O}$

$26.8\ mol\ O = \underline{?}\ g\ O$

$$26.8\ mol\ O \times \frac{16.0\ g\ O}{1\ mol\ O} = 426\ g\ O$$

g ⟷ atoms

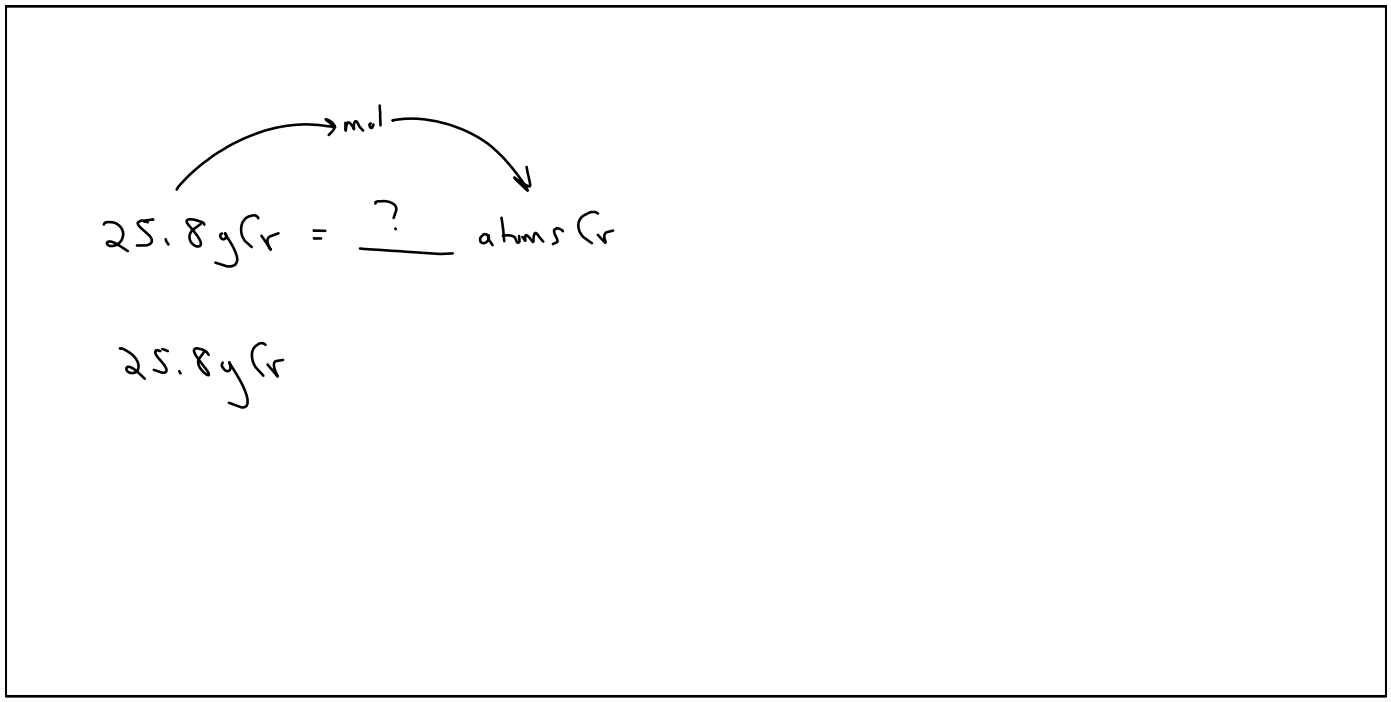
g ⟷ atoms 2 step Problems
↳ must convert to moles 1st

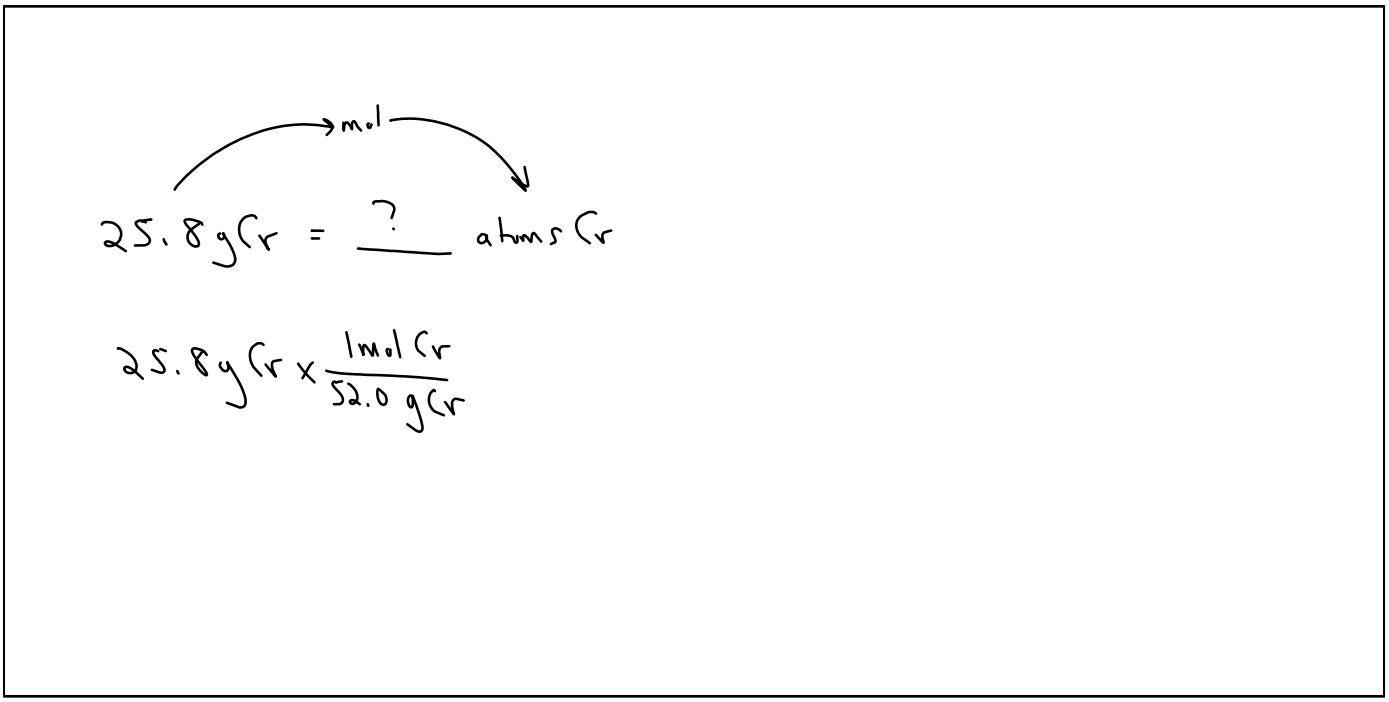
g ⟷ atoms 2 step Problems
↳ must convert to moles 1st

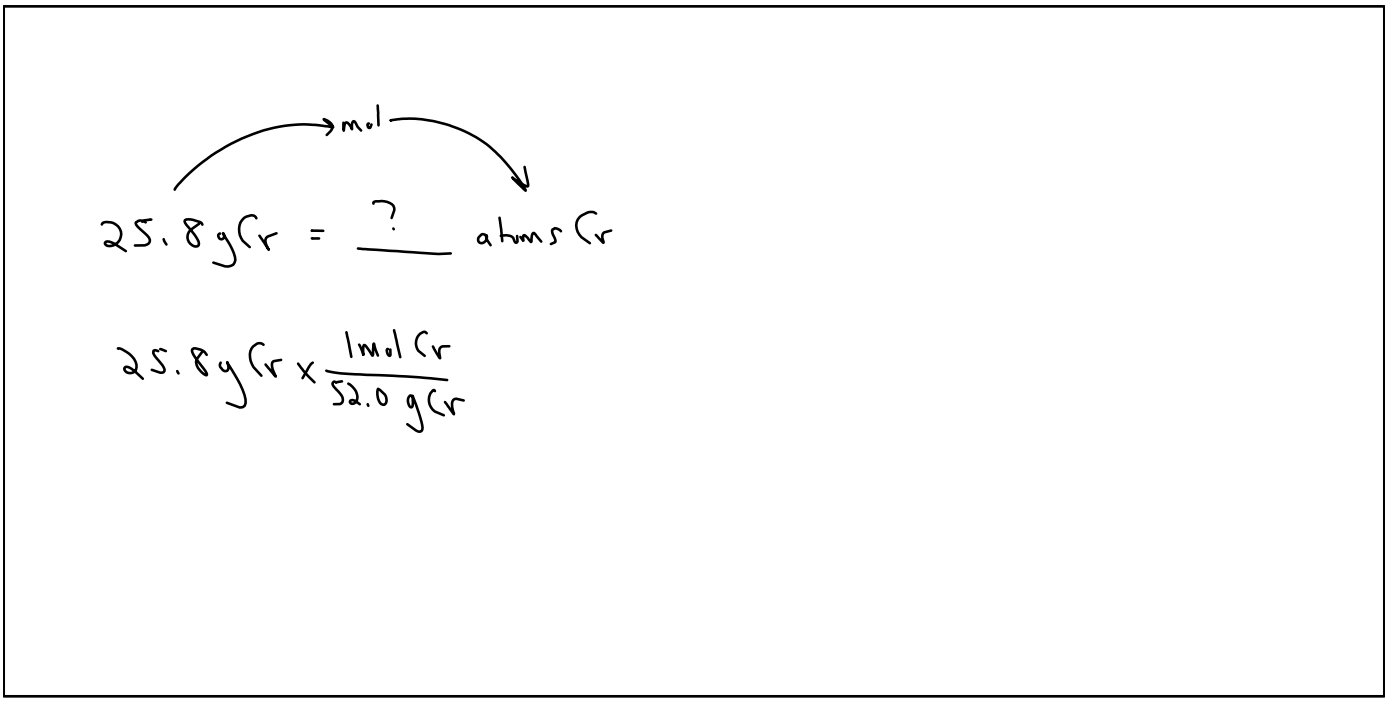
g ⟷ atoms 2 step Problems
↳ must convert to moles 1st

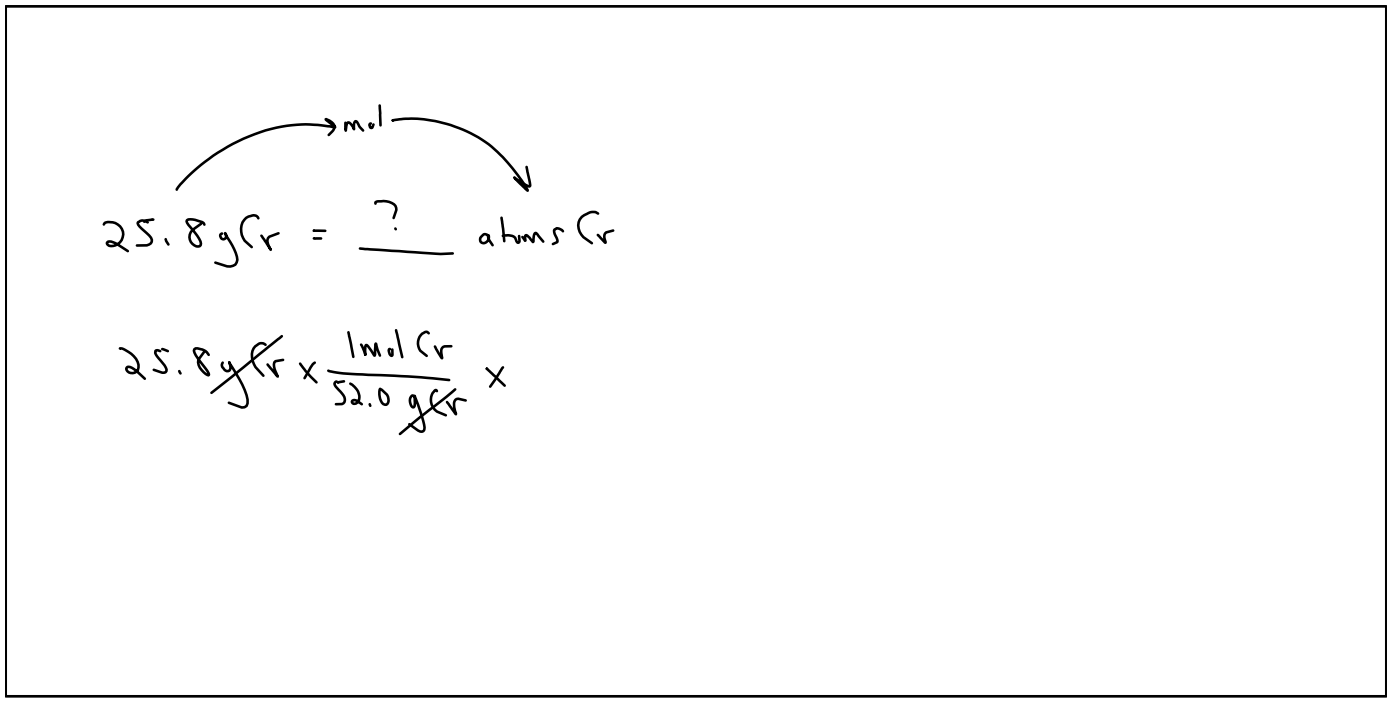
25.8 g Cr : ? atoms Cr

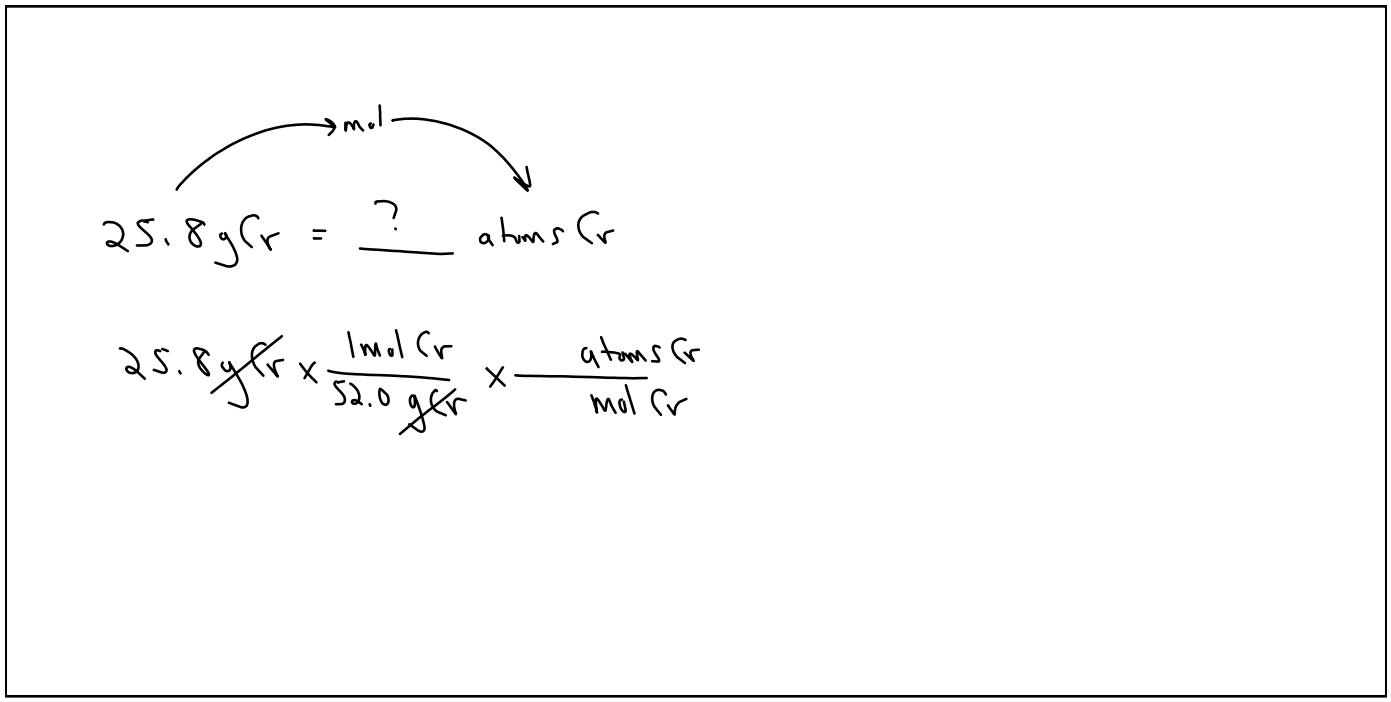
$25.8\ g\ Cr = \underline{\quad ? \quad}\ atoms\ Cr$

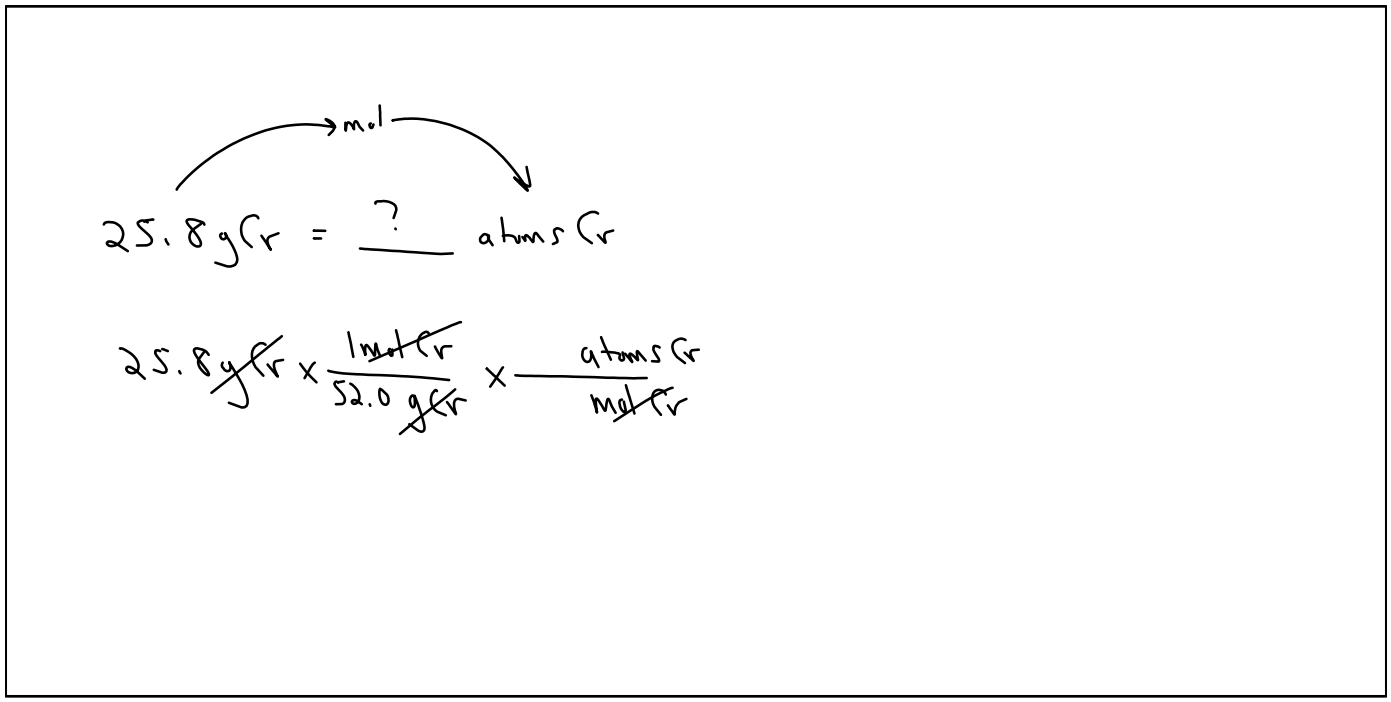

mol
25.8 g Cr = ? atoms Cr
25.8 g Cr

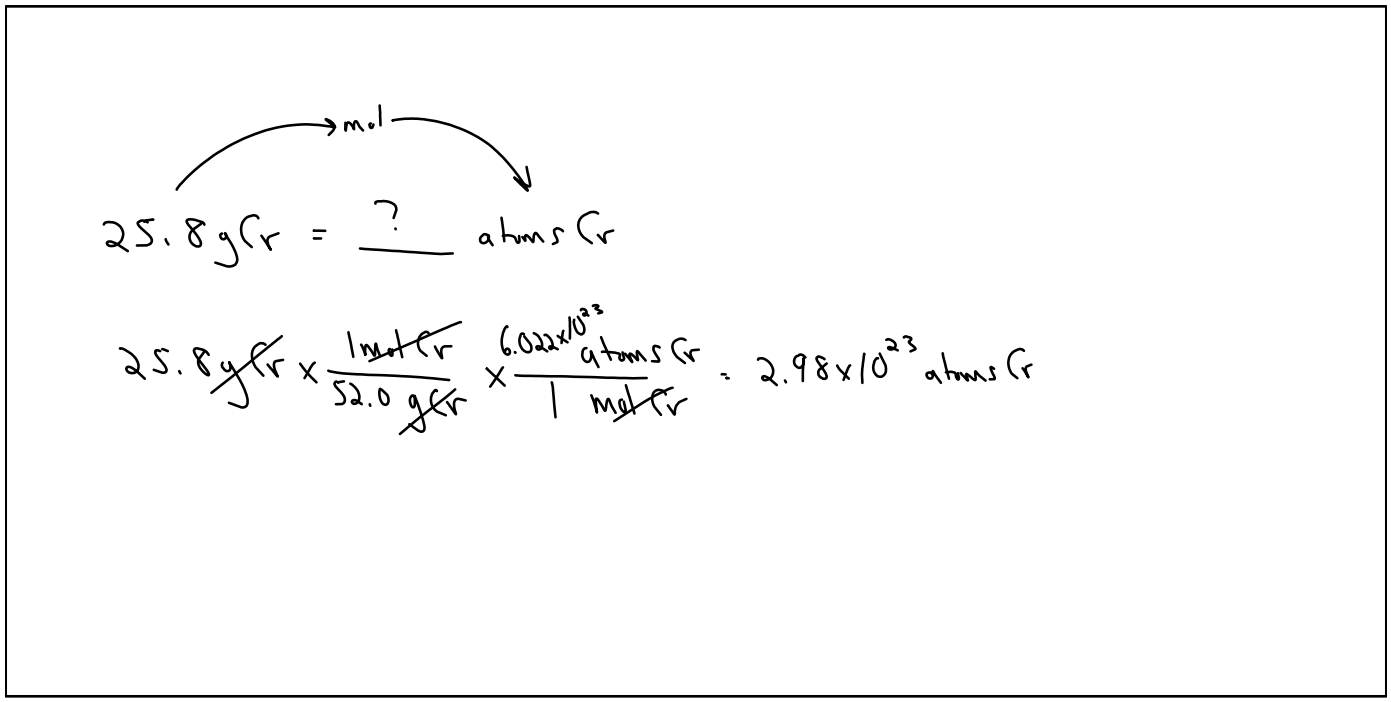

mol
25.8 g Cr = ? atoms Cr
25.8 g Cr x 1 mol Cr / 52.0 g Cr

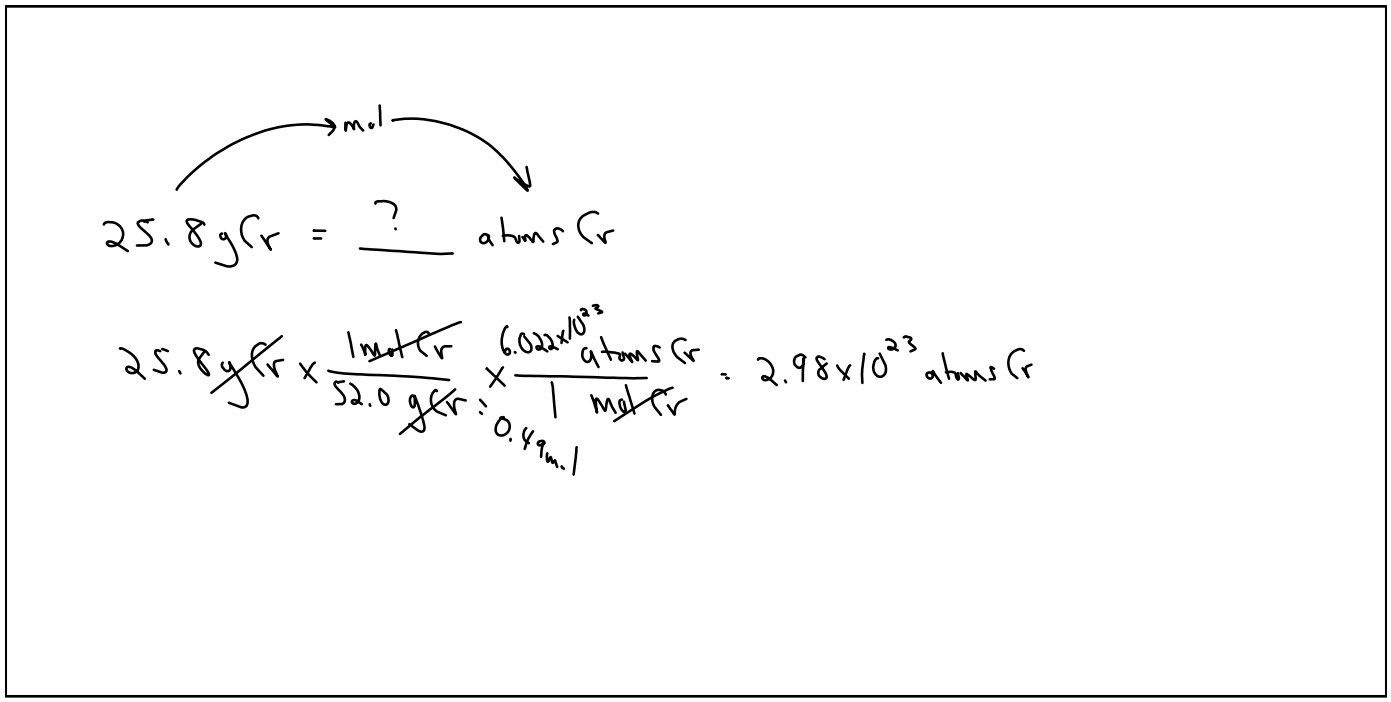

mol
25.8 g Cr = ? atoms Cr
25.8 g Cr x 1 mol Cr / 52.0 g Cr


mol
25.8 g Cr = ? atoms Cr
25.8 g Cr x 1 mol Cr / 52.0 g Cr x


mol
25.8 g Cr = ? atoms Cr
25.8 g Cr × 1 mol Cr / 52.0 g Cr × atoms Cr / mol Cr


mol
25.8 g Cr = ? atoms Cr
25.8 g Cr × 1 mol Cr / 52.0 g Cr × atoms Cr / mol Cr


mol
25.8 g Cr = ? atoms Cr
25.8 g Cr × 1 mol Cr / 52.0 g Cr × 6.022×10^23 atoms Cr / 1 mol Cr = 2.98×10^23 atoms Cr


mol
25.8 g Cr = ? atoms Cr
25.8 g Cr × 1 mol Cr / 52.0 g Cr = 0.496 mol
× 6.022×10^23 atoms Cr / 1 mol Cr = 2.98×10^23 atoms Cr

$64.5\,g\,Ir = \underline{\quad ? \quad}\,atoms\,Ir$

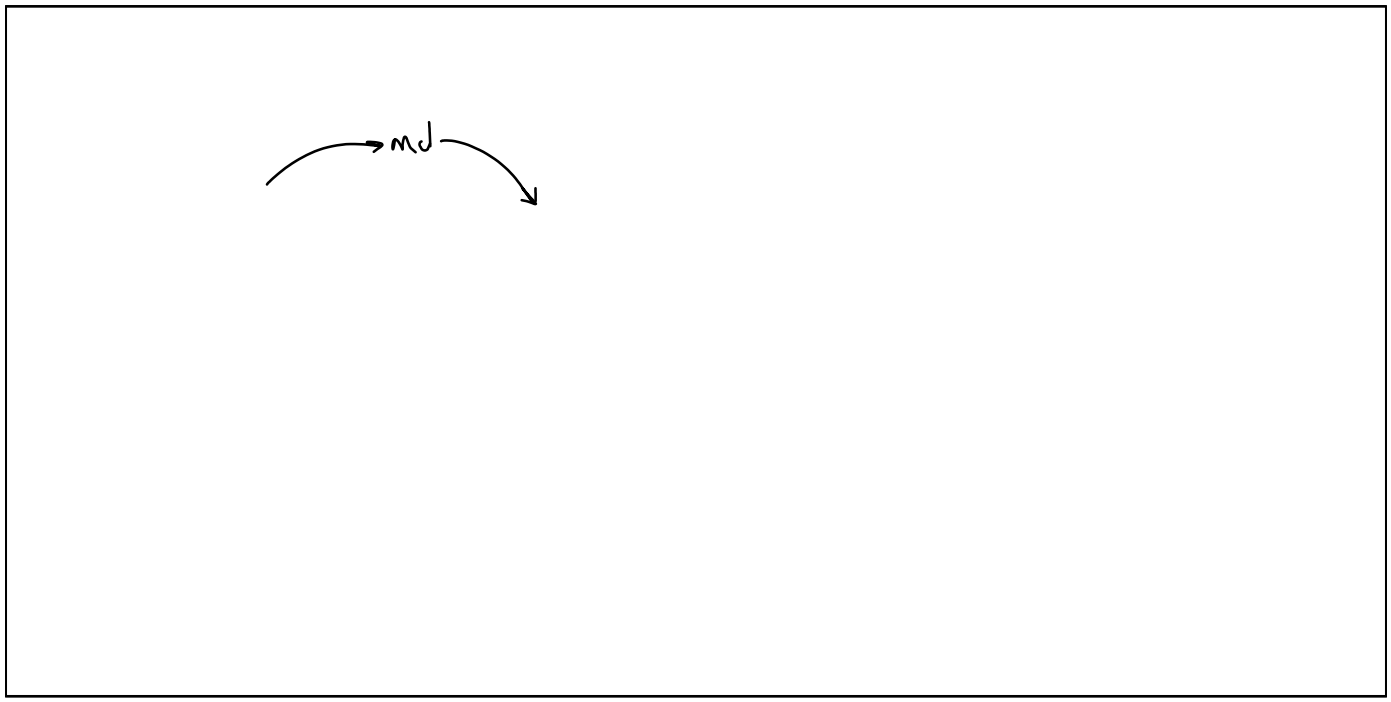
$64.5\,g\,Ir = \underline{\quad ? \quad}\,atoms\,Ir$

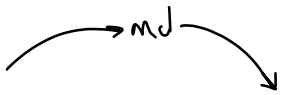
$64.5\,g\,Ir = \underline{\quad ? \quad} \text{ atoms } Ir$

$64.5\,g\,Ir \times \frac{1\,m.l\,Ir}{192\,g\,Ir}$

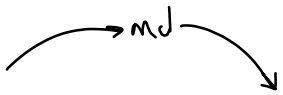
$64.5\ g\ Ir = \underline{\quad ? \quad}\ atoms\ Ir$

$$64.5\ \cancel{g\ Ir} \times \frac{1\ mol\ Ir}{192\ \cancel{g\ Ir}} = 0.335\ mol\ Ir \times \frac{6 \times 10^{23}\ atoms\ Ir}{1\ mol\ Ir} = 2.01 \times 10^{23}\ atoms\ Ir$$

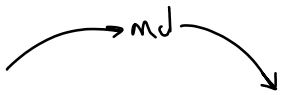

md



$$2.87\times10^{24}\ \text{atoms Ru} \times \frac{1\ \text{mol Ru}}{6\times10^{23}\ \text{atoms Ru}}$$



$$2.87\times10^{24}\ \text{atoms Ru} \times \frac{1\ \text{mol Ru}}{6\times10^{23}\ \text{atoms Ru}}$$



$$2.87\times10^{24}\ \text{atoms Ru} \times \frac{1\ \text{mol Ru}}{6\times10^{23}\ \text{atoms Ru}} \times \frac{101\ \text{g Ru}}{1\ \text{mol Ru}} = 481\ \text{g Ru}$$